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ABSTRACT

This vocational program guide is intended to assist in the organization, operation, and evaluation of a program in industrial electronics in school districts, area vocational centers, and community colleges. The following topics are covered: program content (curriculum framework and student performance standards); program implementation (student admission criteria, cooperative education, and student organization participation); instructional resources; facilities (facility design recommendations and safety, maintenance, and liability); suggested equipment; and professional development (technical updating and teacher standards and related professional organizations and support services). A Career Merit Achievement Plan (Career MAP) for use in recording the progress of students enrolled in an industrial electronics program is packaged with the program guide. Included in the Career MAP are a list of relevant job titles, overview of the MAP and directions for using it, guidelines for rating student performance standards, and charts detailing the various subcompetencies of the industrial electronics skills and work environment readiness skills covered in the industrial electronics program. (MN)

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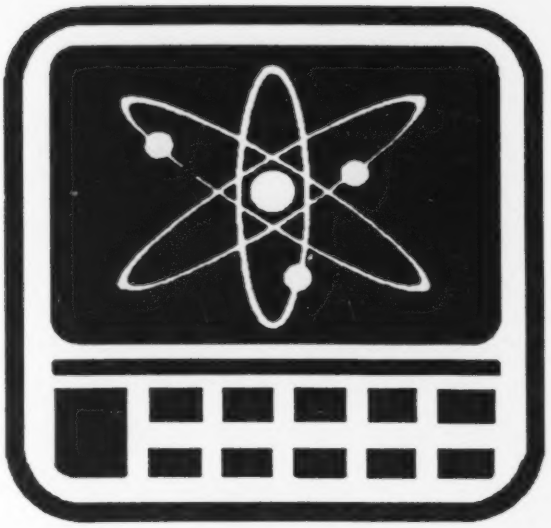

FLORIDA VOCATIONAL PROGRAM GUIDE FOR INDUSTRIAL ELECTRONICS

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INTRODUCTION

Vocational education meets the needs of students desiring to pursue a selected vocation and is designed to provide training that is realistic in meeting present and future employment opportunities. In recent years, applications of science and technology have expanded rapidly, increasing the education and training required of workers. This has made vocational training programs more attractive as an educational option. The new technologies require well-trained workers to carry out both standardized and specialized procedures, and whose training foundations have given them the capacity to keep pace with continuing technology demands.

The Florida Department of Education shares with business and industry the determination to provide opportunities for upward mobility to as many Floridians as possible. Vocational training programs can keep pace with the demands of new industrial patterns and can provide the opportunity for many of our citizens to gain financial stability and an improved sense of self worth. Therefore, it is necessary to create exemplary vocational programs and to make those programs consistent throughout the state.

This Program Guide identifies primary concerns that should be considered in the organization, operation and evaluation of a vocational education program. It has been developed to provide useful information to local school district and community college administrators, instructors, program advisory committees, regional coordinating councils and others charged with the responsibility of offering vocational education programs.

OCCUPATIONAL DESCRIPTION

A principle occupational title is identified for each vocational training program. This title is validated by the United States Department of Labor Dictionary of Occupational Titles (DOT) or other appropriate references. Such references may be the United States Department of Commerce Standard Occupational Classification Manual (SOC), the Occupational Employment Statistics Survey Dictionary (OES), or Vocational Preparation and Occupations (VPO) prepared by the National and State Occupational Information Coordinating Committees. Information obtained from industry advisory committees may also be used to validate the principle occupational title. The job title and code number for this program are listed in the curriculum framework which accompanies this guide.

The United States Department of Labor Dictionary of Occupational Titles (D.O.T.) identifies the job title for this occupational area as follows:

D.O.T. JOB TITLE	D.O.T. CODE
Electronics Mechanics	828.281-010

The definition (description) for this job title is taken from the D.O.T. for easy reference.

ELECTRONICS MECHANICS

Repairs electronic equipment, such as computers, industrial controls, radar systems, telemetering and missile control systems, transmitters, antennas, and servomechanisms, following blueprints and manufacturers' specifications, and using handtools and test instruments: Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using oscilloscopes, signal generators, ammeters, and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using handtools and soldering iron. Alines, adjusts and calibrates equipment according to specifications. Calibrates testing instruments. Maintains records of repairs, calibrations, and tests. May install equipment in industrial or military establishments and in aircraft and missiles. May operate equipment, such as communication equipment and missile control systems in ground and flight tests, and be required to hold license from governmental agency. May be designated according to type of equipment repaired as CUSTOMER-ENGINEERING SPECIALIST (office mach.);

ELECTRONICS MECHANIC, COMPUTER (any ind.); RADAR MECHANIC (any ind.); VOTING-MACHINE REPAIRER (gov. ser.).

PROGRAM CONTENT

The Division of Vocational, Adult, and Community Education, as required by State Board of Education **(S.B.E.) Rule 6A-6.0571**, publishes Vocational Education Program Courses Standards annually. This document specifies the minimum program content for the operation of a vocational training program for the occupational titles listed. Each program identified in the Florida Department of Education Course Code Directory is required to establish course standards. The standards for each vocational offering are comprised of two major components: (1) Curriculum Framework and (2) Student Performance Standards.

Curriculum Framework (CF)

The Curriculum Framework specifies the exact course title, course number, levels of instruction, major course content, laboratory activities, special notes, major course concepts and intended outcomes. The program requirements stipulated in the curriculum framework have been approved by the State Board of Education and are the legal bases for delivery of instruction.

Student Performance Standards (SPS)

The Student Performance Standards are a resource list of job-specific competencies. This list is generated and approved by industry experts and becomes the basis for curriculum development in vocational programs. Local school districts and community colleges must, by law, adopt student performance standards for their vocational programs. They may, at their discretion, adopt the list provided or develop their own as long as there is sufficient content to address each intended outcome. A program may provide instruction beyond the minimum specified in the SPS if desired. The decision to do this should be based on local industry needs. However, the minimum must be presented.

The SPS for secondary level programs contain a third component, course structure. This component specifies the number of courses required for program completion and the content of each course. The courses may be taught in any sequence, but the content may not be changed unless approved by the Division of Vocational, Adult, and Community Education.

The curriculum framework and student performance standards are intended for use as a guide, not a teaching tool. Teachers or curriculum development personnel are expected to develop or select complete curriculum materials for their training programs based on the curriculum framework and student performance standards. Each intended outcome and SPS should be thoroughly analyzed for related cognitive and procedural subskills. The curriculum framework and student performance standards are presented in the following pages.

CURRICULUM FRAMEWORK PROGRAM AREA: Industrial

FLORIDA DEPARTMENT OF EDUCATION EFFECTIVE DATE: July, 1991

PROGRAM TITLE: Industrial Electronics

CODE NUMBER: Secondary _____ Postsecondary EEV0300

Florida CIP 0647.010500

SECONDARY SCHOOL CREDITS ___ COLLEGE CREDITS ____ POSTSECONDARY ADULT VOCATIONAL CREDITS ____

APPLICABLE LEVELS(S): __ 7-9 __ 9-12 X Postsecondary Adult Vocational

__ Postsecondary Vocational X Other 30-31

CERTIFICATION COVERAGE: RADIO TV @7 ELECTRONIC 7 TEC ELEC @ 7

I. MAJOR CONCEPTS/CONTENT: The purpose of this program is to prepare students for employment as electronics repairers (85717609), electronics mechanics 828.281-010. This program also provides supplemental training for persons previously or currently employed in this occupation.

The course content includes, but is not limited to, direct current (DC), alternating current (AC), analog, relay, delay and time delay circuits; solid-state and digital devices; distribution, timing and control systems; microprocessors; industrial power supplies; transformers; DC and AC motors; digital motor controls; manual controllers; magnetic controllers and starters; pressure and strain measurements; temperature, photoelectric liquid level and process control; line diagrams and logic functions; gas and humidity sensing; telemetry; systems interface; schematics; soldering and chassis assembly techniques; laboratory practices; and technical recording and reporting.

The course content should also include training in communication, leadership, human relations and employability skills; and safe, efficient work practices.

II. LABORATORY ACTIVITIES: Shop or laboratory activities are an integral part of this program. These activities provide instruction in the use of tools, equipment, materials and processes found in the industry.

III. SPECIAL NOTE: The Vocational Industrial Clubs of America, Inc. is the vocational student organization which reinforces classroom instruction by providing communications, leadership, human relations and employability training experiences. It also reinforces specific vocational skills. When provided, these activities are considered an integral part of this program.

The cooperative method of instruction may be utilized for this program. When the cooperative method is offered, the following is required for each student: a training plan signed by the student, teacher and

employer which includes instructional objectives and a list of on-the-job and in-school learning experiences; and a work station which reflects equipment, skills and tasks relevant to the occupation the student has chosen as a career goal. The student must receive compensation for work performed.

Electronic Technology and/or Electronic Engineering Technology are prerequisites for entry into this electronic specialization. Algebra is recommended as a prerequisite for entry into this program.

In accordance with Section 233.0695 F.S., the minimum basic skills grade level required for this postsecondary adult vocational program is: Mathematics 10.0, Language 9.0. This grade level number corresponds to a grade equivalent score obtained on a state designated basic skills examination.

To be transferable statewide between institutions, this program/course must have been reviewed, and a "transfer value" assigned the curriculum content by the appropriate Statewide Course Numbering System discipline committee. This does not preclude institutions from developing specific program or course articulation agreements with each other.

This program may be offered in courses. Vocational credit shall be awarded to the student on a transcript in accordance with Section 230.643. F.S.

The typical length of this program for the average achieving student is 600 hours.

01. Demonstrate proficiency in industrial power supplies.
02. Demonstrate proficiency in power distribution systems.
03. Demonstrate proficiency in basic control systems.
04. Demonstrate proficiency in DC motors.
05. Demonstrate proficiency in digital motor control.
06. Demonstrate proficiency in manual controllers.
07. Demonstrate proficiency in magnetic controllers.
08. Demonstrate proficiency in pressure and strain measurements.
09. Demonstrate proficiency in temperature control.
10. Demonstrate proficiency in photoelectric control.
11. Demonstrate proficiency in gas and humidity sensors.
12. Demonstrate proficiency in liquid level controls.
13. Demonstrate proficiency in line diagrams and logic functions.
14. Demonstrate proficiency in timing systems.
15. Demonstrate proficiency in time delay circuits.
16. Demonstrate proficiency in process control.
17. Demonstrate proficiency in telemetry.
18. Demonstrate proficiency in systems interface.

STUDENT PERFORMANCE STANDARDS EFFECTIVE DATE: July, 1991

PROGRAM AREA: Industrial SECONDARY NUMBER:

PROGRAM TITLE: Industrial Electronics POSTSECONDARY NUMBER: EEV0300

01.0 DEMONSTRATE PROFICIENCY IN INDUSTRIAL POWER SUPPLIES--
The student will be able to:

- 01.01 Connect an unregulated power supply, measure voltages and calculate percentage of regulation.
- 01.02 Decrease the power supply impedance to improve regulation.
- 01.03 Connect a shunt regulator circuit.
- 01.04 Connect a series regulator circuit.
- 01.05 Connect a switching voltage regulator.
- 01.06 Set up a DC-to-AC inverter by adding a transformer module.
- 01.07 Connect a delta-primary, wye-secondary arrangement and measure its voltage.
- 01.08 Connect a half-wave power supply and measure voltages, ripple amplitude and ripple frequency.
- 01.09 Connect a three-phase, full-wave power supply and measure output voltages with and without filtering.
- 01.10 Connect a delta-primary, delta-secondary, full-wave power supply and measure output voltages with and without filtering.
- 01.11 Connect the power supply module for single-phase or three-phase output voltage.
- 01.12 Connect a step-down transformer to reduce the incoming voltage.

02.0 DEMONSTRATE PROFICIENCY IN POWER DISTRIBUTION SYSTEMS--
The student will be able to:

- 02.01 Connect and verify single-phase and three-phase transformers in WYE to WYE installations.
- 02.02 Connect and verify single-phase and three-phase transformers in DELTA to DELTA installations.
- 02.03 Connect and verify single-phase and three-phase transformers in WYE to DELTA installations.
- 02.04 Connect and verify single-phase and three-phase transformers in DELTA to WYE installations.

03.0 DEMONSTRATE PROFICIENCY IN BASIC CONTROL SYSTEMS--
The student will be able to:

- 03.01 Connect relays and lamp modules in a control system and determine the pull-in and drop-out currents.
- 03.02 Connect relays and lamp modules in a control system and determine the operating characteristics of solid-state relay.
- 03.03 Connect a multi-pushbutton control circuit for troubleshooting purposes.
- 03.04 Connect a test light for STOP and START pushbuttons.
- 03.05 Connect a test light for a control relay.
- 03.06 Connect an on-off control station with a pilot light.
- 03.07 Connect a solid state limit switch and cycle timer.
- 03.08 Connect a solid state limit switch to a control relay.
- 03.09 Connect a selector switch to a control circuit.

04.0 DEMONSTRATE PROFICIENCY IN DC MOTORS--The student will be able to:

- 04.01 Measure the resistances of the two field coils in a DC motor.
- 04.02 Connect a series type motor.
- 04.03 Measure the current drawn by the motor and calculate the CEMF generated in the motor for unloaded and loaded conditions.
- 04.04 Connect a shunt type motor.
- 04.05 Measure the shunt motor currents and calculate the CEMF.
- 04.06 Operate a compound motor with separate armature and field supply voltages.
- 04.07 Operate a compound motor from a single power supply, with and without load, measuring motor current and observing changes in speed.

05.0 DEMONSTRATE PROFICIENCY IN DIGITAL MOTOR CONTROL--The student will be able to:

- 05.01 Connect a stepping motor to its DC supply.
- 05.02 Vary the speed and direction of rotation of the stepping motor.
- 05.03 Program the logic source to make the motor perform in a predictable patter.
- 05.04 Program the stepping motor for control of rotary or linear displacement.

06.0 DEMONSTRATE PROFICIENCY IN MANUAL CONTROLLERS--The student will be able to:

- 06.01 Connect a manual starter to operate a three-phase motor.
- 06.02 Troubleshoot a manual starter.
- 06.03 Change motor rotation using a drum switch.

07.0 DEMONSTRATE PROFICIENCY IN MAGNETIC CONTROLLERS--The student will be able to:

- 07.01 Connect a standard start-stop pushbutton station to operate a magnetic motor starter.
- 07.02 Troubleshoot the control circuit and the power circuit.
- 07.03 Connect start-stop pushbutton stations to control magnetic starters.
- 07.04 Connect the STOP pushbutton through a logic relay for NOT, NOR, AND and NAND circuit logic.
- 07.05 Connect motors arranged for sequence control of a conveyor system.
- 07.06 Interconnect starters to control a conveyor system so as to prevent pile ups and assure safe operation.
- 07.07 Connect a motor using a selector switch and a jogging relay.

08.0 DEMONSTRATE PROFICIENCY IN PRESSURE AND STRAIN MEASUREMENTS--The student will be able to:

- 08.01 Connect a linear Hall sensor.
- 08.02 Apply amplification to the linear Hall sensor.
- 08.03 Connect a digital Hall sensor as a hysteresis type of load switch.

08.04 Connect a digital Hall sensor as a sensitive load cell.
08.05 Connect the AC response of the linear variable differential transformer (LVDT) to indicate mechanical position change.

09.0 DEMONSTRATE PROFICIENCY IN TEMPERATURE CONTROL--The student will be able to:

09.01 Connect a temperature module, calibrate the integrated circuit for reading temperature and measure the cold resistance of the thermistor.
09.02 Measure temperature by using a thermocouple mounted on an op-amp module.
09.03 Apply amplified voltage change at the op-amp output to operate a solid-state relay and an indicating device.
09.04 Use an op-amp, relay, lamp and temperature module to set up a system that maintains temperature at a constant level.
09.05 Connect a bridge, temperature module and thyristor module into a closed-loop temperature control system.
09.06 Connect a voltage-controlled oscillator module and determine the range of control voltage necessary for oscillation.
09.07 Connect a temperature and voltage-controlled oscillator module to provide digital readout of temperature.

10.0 DEMONSTRATE PROFICIENCY IN PHOTOELECTRIC CONTROL--The student will be able to:

10.01 Connect a photoconductive cell and incandescent lamp and measure the effect on photocell resistance.
10.02 Use a photo-Darlington transistor to receive light from an incandescent lamp and measure its effect on collector voltage with a change of light intensity.
10.03 Connect a photoelectric relay circuit to turn lights on and off.
10.04 Operate and adjust a fiber optic transmitter for minimum distortion.
10.05 Operate and adjust a fiber optic receiver for maximum sensitivity and minimum distortion.
10.06 Transmit a voice signal from a transmitter to a receiver through an optical cable.
10.07 Transmit digital data through an optical cable.

11.0 DEMONSTRATE PROFICIENCY IN GAS AND HUMIDITY SENSORS--The student will be able to:

11.01 Measure the resistance of a hygropak humidity sensor under varying conditions of humidity.
11.02 Simulate a wet and dry bulb humidity measurement device using a thermistor as the active element.
11.03 Connect a gas detector circuit using a Taguchi gas sensor and measure its cold and hot resistances.
11.04 Use a gas sensor as a smoke detector, coupled with a solid-state relay and lamp, to act as an indicator.

12.0 DEMONSTRATE PROFICIENCY IN LIQUID LEVEL CONTROLS--The student will be able to:

- 12.01 Connect a level switch to control a pump motor for sump operation.
- 12.02 Add a timer to a level control circuit to keep the pump motor running for a set time after the level has dropped.
- 12.03 Add a time to level control circuit to start a second pump motor if the first cannot lower the level after a given time.
- 12.04 Use the float switch control starter for tank operation.
- 12.05 Use the pump operating system to provide backspin and surge protection on stopping.

13.0 DEMONSTRATE A PROFICIENCY IN LINE DIAGRAMS AND LOGIC FUNCTIONS--The student will be able to:

- 13.01 Connect control switches for AND circuit logic.
- 13.02 Connect control switches for OR circuit logic.
- 13.03 Connect a control switch for NOT circuit logic.
- 13.04 Connect switches for NOR circuit logic.
- 13.05 Connect control switches for NAND circuit logic.
- 13.06 Connect a logic relay for OR circuit logic.
- 13.07 Connect a logic relay for AND circuit logic.
- 13.08 Connect a logic relay for NOR circuit logic.
- 13.09 Connect a logic relay for NAND circuit logic.
- 13.10 Connect a control relay in a circuit to add memory to the circuit.
- 13.11 Connect a logic relay together with a control relay to form a combination of memory with either OR or AND logic.

14.0 DEMONSTRATE PROFICIENCY IN TIMING SYSTEMS--The student will be able to:

- 14.01 Construct a time delay circuit using an RC network and a silicone controlled rectifier.
- 14.02 Adjust the time delay relay circuit for different time delays.
- 14.03 Use a frequency divider as a timing device to obtain different time delays.
- 14.04 Change the repetition rate of the signal applied to a frequency divider to obtain different time delays.
- 14.05 Combine the inputs and outputs of two frequency dividers to increase the total division and obtain time delays using a signal having a higher repetition rate.
- 14.06 Connect a time delay circuit using an integrated circuit and a solid-state relay and measure different time delays.
- 14.07 Connect a time delay circuit using an operational amplifier to keep a device turned off for a definite period of time.
- 14.08 Measure the frequency or repetition rate of a sine-wave or square-wave signal.
- 14.09 Change the function gate time and determine the readout on a digital counter.
- 14.10 Use the digital counter to measure low frequencies by measuring the period of a waveform or pulse.

15.0 DEMONSTRATE PROFICIENCY IN TIME DELAY CIRCUITS--The student will be able to:

- 15.01 Connect an on-delay timer to sequence start two motors.
- 15.02 Connect an on-delay timer to automatically turn off a second motor while the first remains on.
- 15.03 Connect an off-delay timer to keep a second motor running for a set period of time after the first is turned off.
- 15.04 Connect an off-delay timer used to prevent a motor from restarting until the time setting is past.
- 15.05 Connect an off-delay timer for deceleration control.
- 15.06 Connect a one-shot timer to keep a load turned on for a set period of time regardless of how long the switch-on control is closed.
- 15.07 Use a one-shot timer to turn on a second motor for a short period of time after the first motor is started.
- 15.08 Connect a recycle timer into a two-wire control circuit.
- 15.09 Connect a recycle timer into a three-wire control circuit.

16.0 DEMONSTRATE PROFICIENCY IN PROCESS CONTROL--The student will be able to:

- 16.01 Explain the operation of a two-position controller and its applications.
- 16.02 Describe the effects of widening the proportional band.
- 16.03 Evaluate a proportional circuit based on test data.
- 16.04 Describe the action of a backup control in a proportional circuit.
- 16.05 Describe the operation of a direct digital control in an industrial process.

17.0 DEMONSTRATE PROFICIENCY IN TELEMETRY--The student will be able to:

- 17.01 Connect a telemetry transmitter to a power supply and observe the carrier output waveform with and without modulation.
- 17.02 Measure the carrier frequency of a telemetry transmitter and observe the effects of modulation on the frequency.
- 17.03 Measure the input frequency of a telemetry receiver.
- 17.04 Measure the band-pass of a telemetry receiver.
- 17.05 Transmit a 200 Hz audio tone between two separate points using a telemetry transmitter and receiver.
- 17.06 Transmit an analog voltage between two separate points using a telemetry transmitter and receiver.
- 17.07 Transmit two separate information channels using a single carrier and time-division multiplexing.

18.0 DEMONSTRATE PROFICIENCY IN SYSTEMS INTERFACE--The student will be able to:

- 18.01 Construct a frequency shift keying (FSK) generator using frequency division.
- 18.02 Construct an FSK generator using a voltage-to-frequency converter.
- 18.03 Set up and adjust a phase-locked loop frequency-to-voltage converter.
- 18.04 Use a frequency-to-voltage converter to demodulate an FSK signal.
- 18.05 Set up and adjust a charge-pump frequency-to-voltage converter.

18.06 Verify the truth table of a BCD coded switch.
18.07 Verify the analog output voltage of a four-bit digital-to-analog converter.
18.08 Connect an analog-to-digital converter and observe ramp generation and counter operation.
18.09 Calibrate a binary-ramp analog-to-digital converter.
18.10 Generate binary numbers 0000 through 1111 and verify their analog equivalents.
18.11 Interface a four-bit digital signal with a heating element and observe its controlling effect.
18.12 Interface a four-bit digital signal with a light bulb and observe on-off control.

PROGRAM IMPLEMENTATION

It is the teacher's responsibility to ensure that students learn how to competently perform the tasks specified in the course objectives. Therefore, the teacher must lead the students through the learning experiences in a course, motivate students, act as a role model for students, and at times, function as a guidance counselor and placement coordinator. This leadership role requires the teacher to participate in many of the activities required for program implementation. The teacher must select the methods of instruction that best apply to students' ability levels, measure student achievement and provide feedback. Key factors that must be considered when implementing this program are addressed below.

TEACHER CHARACTERISTICS

Subject Knowledge

The teacher must be a subject matter expert who is able to implement sound instructional methods and evaluate student performance. He/she must have significant work experience in the industry/vocational field and be able to communicate that knowledge to the students.

Instructional Delivery

The teacher's role in the learning process is to motivate and lead the student as well as impart subject matter knowledge. In order to maximize student learning, the use of a variety of instructional methods is encouraged. Because teaching styles vary greatly, teachers are highly encouraged to "pick and choose" from various methods or to combine methods for maximum benefit to students. Some of the more traditional methods used are lecture, demonstration and small group instruction. Other teaching methods which are suggested for further exploration include individualized self-paced, open-exit/open-entry, contract, computer based and competency based instruction. The focus of Competency Based Vocational Education (CBVE) is to ensure that each student can competently perform tasks specified before progressing to more complex skills.

CONVENTIONAL INSTRUCTIONAL METHODS

A vocational program may require a portion of the instruction to be presented in a standard lecture or controlled demonstration format. These methods of instruction can be easily combined with instructor controlled step-by-step practical exercises. Some instructional activities may dictate that this instructional approach be used to introduce students to hazardous equipment often utilized in vocational training. In most situations, students should be required to perform specified activities to achieve maximum skill competency. If mastery of a task is required, competency based education methods may be more appropriate. However, if the training activity involves an orientation or a seldom performed, non-essential task, conventional instructional methods may be more effective. Teachers are encouraged to use a variety of instructional methods to best meet instructional objectives.

Instructional Development

Teachers often must develop and select their own teaching and curriculum materials. In developing a comprehensive curriculum, instructional objectives based upon both the performance and cognitive domain must be included. When developing curriculum materials, teachers must use the curriculum framework (CF) and student performance standards (SPS) contained in this program guide as a basis. These materials delineate minimim program content which must be presented for an approved vocational training program. However, they are not intended for use as a comprehensive curriculum. Be certain not to adapt the curriculum to available materials, but select only those materials which can be adapted to the curriculum.

Instructional Measurement

Teachers must select testing methods that support the instructional delivery system used. Teachers must be competent to develop, administer and evaluate written and performance type tests.

Student Admissions Criteria

Providing the student the opportunity to successfully complete a vocational education program, in any institution, should be the primary concern of the instructional effort. Therefore, it is very important to direct planning and effort into identifying and selecting students with excellent potential for success in the educational program and in the occupation. The school's primary task is to prepare people for fulltime, entry-level positions as technicians or, in the case of those with more experience, as managers.

The Course Code Directory, specifies grade levels at which occupational programs are offered. Specific student admissions criteria which are required by the State and local educational agencies for the Industrial Electronics training program are illustrated as follows.

SPECIFIC ADMISSIONS CRITERIA

Minimum Age:	As required by state and local policy
Physical Requirements:	None
Special Requirements:	None
Minimum Basic Skills Math Level:	* 10.0
Minimum Basic Skills Language Level:	* 9.0

* This grade level requirement is specified in the Curriculum Framework and is applicable to postsecondary level programs of 450 hours or more only. There is no minimum basic skill requirement for secondary programs.

THE STUDENT PROFILE

Developing a student profile is an important step in program implementation. Attention should focus on student characteristics that can be remediated within a training program, but could create serious impediments to success in the vocational field. Typical of these would be deficiencies in communication and mathematical skills. The basic skill levels can be measured by testing. Test results can then be used to direct the student to more suitable training which matches his or her skill level, or to determine supplemental training which may be required to increase chances for student success.

High school and postsecondary vocational students can be admitted to a vocational program upon request if they meet any specified prerequisites, such as physical or basic skill requirements. Training programs should be accessible to as many students as possible. Training programs are designed to prepare students for employment upon graduation, or serve as prerequisite to a postsecondary program.

The community college can be more selective and establish stringent admission standards. This may be done by assessing applicants or by recruiting potential students who meet the established prerequisite requirements of the training. The program advisory committee can design a profile of the potentially successful student. The profile should contain a

list of qualities, traits and aptitudes that will indicate a higher potential for student success. Acceptable levels for these traits must also be determined. For example, the qualities deserving highest attention, mechanical ability and cognitive aptitude, are those which the educational program itself will not likely be able to influence, although these traits should have considerable weight in establishing the basic profile. Deficiencies in mathematical or communication skills may lend themselves to improvement through related instruction while the student is enrolled in the program. The following example illustrates specific qualities to consider when establishing the student profile:

Mechanic/Technician--Service

- Knowledge of basic tools and equipment used by mechanics/technicians
- Ability to analyze and solve mechanical and technical problems
- Ability to interpret written mechanical/technical materials
- Ability to interpret mechanical/technical drawings
- Mechanical dexterity

Mechanic/Technical Service Management

- Basic application of service
- Business skills
- Ability to work with people
- Communication skills
- Leadership

QUALIFYING AND PRETESTING

Assessing potential students for vocational programs is an integral part of the recruiting process since considerable amounts of time and money will be spent on students entering training. Recruiters must have a good idea of the candidate's basic aptitude. Whoever guides the candidate to the program needs to have knowledge of the student's interests, abilities and experience. These can be measured by a variety of assessment methods, which should be performed upon program entry. The assessment can help determine extent and level of training each individual should receive.

The minimim basic skills requirement for mathematics and language skills is specified on the curriculum framework. Assessment should determine the level at which the student can read, write, calculate mathematics and understand the English language. It is appropriate for the program advisory committee and the school to develop some selection criteria based on minimum skill levels. These criteria should remain flexible in order to maximize educational opportunity for all applicants. Additionally, vocational educators must make every effort to serve the variety of "special needs" students and to eliminate sex-bias and stereotyping in all occupational areas.

ADVISORY COMMITTEE

It is imperative that representatives of industry be organized into an advisory committee. Constantly changing technological demands of our society will continue to stimulate changing industrial patterns. Therefore, effective use of program advisory committees is vital to the successful implementation of vocational training programs. Advisory committees provide expert technical advice which is not easily obtainable elsewhere, offer external support of policies and have tremendous public relations potential.

The most effective advisory committees are those whose members have mutual respect for each other's abilities and vested interest in the training program because of their need for trained workers. The program advisory committee is also one of the most effective means of facilitating placement. Its role can be:

- To contact local industry and encourage them to use the school's placement office as a means of filling jobs
- To develop an effective procedure for interviewing and evaluating potential employees suggested by the school
- To assist in gathering accurate and current job information as it becomes available

COUNSELING AND GUIDANCE

Counseling of students serves two purposes. It guides the student into the program and it supports enrolled students on a continuing basis throughout the program. Much day-to-day counseling will be the responsibility of the teacher. The teacher has the most contact with the student and is in a position to detect and correct a problem. Each student will encounter new problems as the program develops. The teacher's job is to work with the student to help identify problems and then strive for solutions. The teacher will provide much of the counseling that focuses on trade knowledge and skills.

The professional counselor cannot be expected to have the subject matter expertise of the primary teacher. The counselor, however, can focus on the student's needs related to other issues such as personal growth, interests and attitudes. The ideal situation will provide at least one counselor with current knowledge of industry standards for career counseling. A useful tool which should be used in the counseling process is the Career Merit Achievement Plan (Career MAP) which presents minimum instructional content keyed to student performance standards. Career MAPs are available for each industrial program area, and can be used to document student achievement, isolate student interests, talents and weaknesses. They are also useful for placement purposes. Information on Career MAPs may be obtained by contacting the Department of Education, Division of Vocational, Adult, and Community Education, (904) 488-0484.

STUDENT PLACEMENT

Implementing an effective placement system is integral to developing a successful vocational training program. **S.B.E. Rule 229.551 (3)(g)** requires 70 percent placement of students who have completed a vocational training program. Although placement is not always a problem, as with students already working in a related occupation, the placement program should place emphasis upon students who are seeking entry-level employment since these students have little or no experience with industry.

The task of the placement program is to locate job openings in the community. The placement coordinator or teacher must know each student's personal aims and interests in addition to the information stated on the achievement record. In many cases, teachers are the best source to match students to job openings because of their contacts with the industry advisory committee. Input concerning employment openings must come from individual business establishments in the community. The placement coordinator should introduce a student to as many suitable job openings as possible. Conversely, employers can then be expected to interview as many qualified candidates as possible.

Cooperative Education

COOPERATIVE EDUCATION APPLICABILITY

Normally, a student will complete the entire program as a full-time student before obtaining employment as an electronics mechanic. However, there may be situations where a student could be allowed to complete part of the program while employed as an electronics mechanic. At this time it is appropriate for the student to enroll in industrial cooperative education (ICE). Guidelines for this training plan are provided in the "Industrial Cooperative Education Program Guide," published by the Division of Vocational, Adult, and Community Education, Order # IE 508 BK 87.

Industrial cooperative education is a method of instruction designed to prepare students for jobs in the community. This method is a joint effort between the school and the business community. Student trainees receive a combination of instruction in the classroom and related on-the-job training through employment. Learning experiences are jointly planned and supervised by the teacher and the employer. Cooperative education is relevant to the needs of the student preparing for a work role, and will help the student to achieve success and personal satisfaction as the transition is made from school to the constantly changing world of work.

Cooperative education is defined in the Federal Register, Volume 39, number 143, Vocational Education, Section 102.96, as a program ". . . to prepare students for employment, through: (a) providing meaningful work experiences combined with formal education enabling students to acquire knowledge, skills, and appropriate attitudes, (b) removing the artificial barriers which separate work and education, (c) involving educators with employers, creating interaction whereby the needs and problems of both are made known, thereby making it possible for occupational curricula to be revised to reflect current needs in various occupations . . . ."

PURPOSE

Cooperative Education is for persons who, through written cooperative arrangements between the school and employers, receive instruction, including required academic courses and related instruction by alternation of study in school with a job in any industrial occupational field. These two experiences must be planned and supervised by the school and employers so that each contributes to the student's education and employability. Work periods and school attendance may be on alternative half days, full days, weeks or other periods of time to fulfill objectives of the cooperative education program.

GOALS AND OBJECTIVES

The primary goal of the cooperative method of vocational education is to prepare skilled, responsible individuals who can assume a productive role in the community. Specific objectives to meet the primary goal are:

- To prepare individuals for employment, adjustment and advancement in specified occupations or occupational areas (primary objective)
- To provide an understanding of the contribution of work to the social and economic welfare of our nation
- To provide students with an understanding and appreciation of the American free enterprise system
- To foster an awareness of the civic, social and moral responsibilities of individuals to society

- To stimulate students' interest in their chosen occupational fields and provide an understanding of the opportunities in each field
- To provide training that results in increased efficiency in performing job tasks
- To provide curriculum which is sensitive and adaptable to changes in occupational practices and procedures as they are affected by societal, economic, technical and educational developments
- To strive to develop a greater appreciation of the value of specifically trained personnel among employers, employees and consumers
- To reinforce skills learned in the school laboratory
- To provide experiences on tools and equipment not available in the school laboratory
- To supplement and broaden the school curriculum into areas not otherwise available

Student Organization Participation

Vocational student organizations operate pursuant to federal and state laws, which authorize them as viable components of vocational education programs. According to federal regulations, the vocational education program of instruction may include activities of vocational student organizations which are an integral part of the vocational instruction offered and which are supervised by vocational education personnel. The **S.B.E.** Rules authorize vocational student organizations as an integral part of the vocational education program as stated in **S.B.E. 6A-6.064 (7)** and **6A-6.065 (8).**

VOCATIONAL INDUSTRIAL CLUBS OF AMERICA (VICA)

VICA is an organization for secondary or postsecondary students enrolled in trade and industrial education programs in high schools, area vocational technical centers and junior and community colleges. It is the only national and international organization for trade and industrial students. The organization is designed to expand and enrich opportunities for leadership, social awareness and civic responsibility in vocational students.

Students who participate in VICA activities are often better prepared for the world of work. They acquire knowledge of the many opportunities available in their chosen careers and become aware of the value of their

contributions to society. They are also given opportunities to develop and utilize their talents and abilities in ways that otherwise would not be available to them.

BENEFITS OF VICA MEMBERSHIP FOR THE STUDENT

Membership in VICA offers the student the opportunity for growth and development in the following areas:

School and Community Service Activities Students in VICA become involved in various school and/or community services. These may include clothing or food collections for the needy, donation of time and service to the elderly and participation in fund raisers or similar activities.

Social Interaction with Fellow Students Activities are also available that offer students time for relaxation and fun. Social activities of this type may be held on a regular basis. They might be held on the school campus during school hours, or off campus after school. More formal functions would include end of the year award banquets or industry/employer appreciation dinner banquets.

Competition in Skill and Leadership Contests VICA offers various contests in all the skill and leadership areas it serves. Often, teachers identify talented students who represent their school in regional competitions. However, any student member of VICA may compete. Instructors should conduct planned contests within their trade areas. This also pertains to leadership areas. First and second place regional winners then move on to the state level contest. The state winners then compete at the national level of the United States Skill Olympics.

INSTRUCTIONAL RESOURCES

STUDENT REFERENCE MATERIALS

Necessary instructional texts or pertinent material should be available for each student to satisfy training objectives. When textbooks are used, the copyright date should be as current as possible.

SERVICE MANUALS

Manuals with current manufacturer's service procedures and specifications should be available. These manuals must be located where students can use them while working in the shop area.

PERIODICALS

Current general and technical magazines and newspapers should be available for student and instructor use.

The following list of suggested resources is organized under each outcome shown in the curriculum framework. These resources have been recommended by instructors and program administrators.

01.0 DEMONSTRATE PROFICIENCY IN INDUSTRIAL POWER SUPPLIES

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Parallel Circuits	BERGWALL PRODUCTIONS	film
Resistor and Complex Circuits	BERGWALL PRODUCTIONS	film
Series Circuits	BERGWALL PRODUCTIONS	film
Electronic Power Supplies 806 (1-8)	BERGWALL PRODUCTIONS	film & cassettes
Electric Machines and Power Systems Vincent Del Toro	PRENTICE-HALL, Division of Simon & Schuster	text
Electric Motor Controls Rockis, Mazur	AMERICAN TECHNICAL PUBLICATIONS, INC.	text
Radio Handbook William Orr	HOWARD S. SAMS & CO.	text
Industrial Electronics *A Text - Lab Manual* Zbar & Koelker ISBN 0-07-072822-4	MCGRAW-HILL	text

02.0 DEMONSTRATE PROFICIENCY IN POWER DISTRIBUTION SYSTEMS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Basic Principles of Power Electronics Klemens Heumann	AMATROL INC.	text

03.0 DEMONSTRATE PROFICIENCY IN BASIC CONTROL SYSTEMS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
American Electricians' Handbook T. Croft, W. Summers	McGRAW-HILL BOOK COMPANY	text
McGraw-Hill's National Electrical Code Handbook	McGRAW-HILL BOOK COMPANY	text
Switchgear and Control Handbook R. W. Smeaton	McGRAW-HILL BOOK COMPANY	text

04.0 DEMONSTRATE PROFICIENCY IN DC MOTORS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Alternating Current-What is it?	BERGWALL PRODUCTIONS	film
Magnetism and Electromagnetism	BERGWALL PRODUCTIONS	film
O'scopes Determining Frequency	BERGWALL PRODUCTIONS	film
O'scopes Operation: Measuring Voltage	BERGWALL PRODUCTIONS	film
O'scopes and How to use them	BERGWALL PRODUCTIONS	film
Voltage and Power	BERGWALL PRODUCTIONS	film
Rotating Machinery 810 (1-5)	BERGWALL PRODUCTIONS	film & cassettes
Electric Motor Repair Robert Rosenberg	HOLT, RINEHART & WINSTON, Division of CBS College Publishing	text

Electric Motors Edwin P. Anderson, revised by Rex Miller	HOWARD W. SAMS AND COMPANY, Division of Macmillan, Inc.	text
Fractional and Subfractional Horsepower Electric Motors G. G. Veinott	McGRAW-HILL BOOK COMPANY	text
Industrial Electronics Humphries, Sheets ISBN 0-8273-3828-7	DELMAR PUBLISHING	text
Industrial Motor Control Herman, Alerich ISBN 0-8273-2380-8	DELMAR PUBLISHING	text
Motor Application and Maintenance Handbook Robert W. Smeaton	McGRAW-HILL BOOK COMPANY	text

05.0 DEMONSTRATE PROFICIENCY IN DIGITAL MOTOR CONTROL

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Inductors	BERGWALL PRODUCTIONS	film
Inductors and Capacitors in AC Circuits	BERGWALL PRODUCTIONS	film
Transformers	BERGWALL PRODUCTIONS	film
Digital Techniques, Analog and Digital Control Robert P. Leach	SCIENCE INSTRUMENTS COMPANY	text
Integrated Circuits in Digital Electronics Arpad Barna, Dan I. Porat	JOHN WILEY & SONS, INC.	text

Microprocessor Applications, Book 1 Andrew C. Staugaard, Jr. EB-6405	HEATH COMPANY, VEC EDUCATIONAL DIVISION	text

06.0 DEMONSTRATE PROFICIENCY IN MANUAL CONTROLLERS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Capacitors and Capacitive Reactane	BERGWALL PRODUCTIONS	film
Rotating Vectors	BERGWALL PRODUCTIONS	film
Series LC Circuits	BERGWALL PRODUCTIONS	film
Vectors and Vector Analysis	BERGWALL PRODUCTIONS	film
Three Phase AC Motors 1-4 813 (1-4)	BERGWALL PRODUCTIONS	video

07.0 DEMONSTRATE PROFICIENCY IN MAGNETIC CONTROLLERS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Parallel LC and LCR Circuits	BERGWALL PRODUCTIONS	film
Parallel Resonance	BERGWALL PRODUCTIONS	film
Series LCR Circuits	BERGWALL PRODUCTIONS	film
Series Resonance	BERGWALL PRODUCTIONS	film

08.0 DEMONSTRATE PROFICIENCY IN PRESSURE AND STRAIN MEASUREMENTS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Instrumentation and Measurement for Electronics Technicians Gilles	MERRILL PUBLISHERS	text
Microprocessor Applications Book 2 EB-6405	HEATH COMPANY, VEC EDUCATIONAL DIVISION	text
Transducer and Instrumentation	HARCOURT BRACE JOVANOVICH	text

09.0 DEMONSTRATE PROFICIENCY IN TEMPERATURE CONTROL

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE

NONE

10.0 DEMONSTRATE PROFICIENCY IN PHOTOELECTRIC CONTROL

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE

NONE

11.0 DEMONSTRATE PROFICIENCY IN GAS AND HUMIDITY SENSORS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Photoelectric Sensors and Inductive Proximity Switches	RAMCO ELECTRIC CO.	catalog

12.0 DEMONSTRATE PROFICIENCY IN LIQUID LEVEL CONTROLS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Programmable Fluid Controllers	SCIENCE INSTRUMENTS COMPANY	text

13.0 DEMONSTRATE PROFICIENCY IN LINE DIAGRAMS AND LOGIC FUNCTIONS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Computer Logic Principles and Techniques David Hutchinson, Peter Silvester	MOTOROLA COMMUNICATIONS AND ELECTRONICS, INC.	text
Technicians Guide to Programmable Controllers Richard Cox ISBN 0-8273-2830-3	DELMAR PUBLISHING	text

14.0 DEMONSTRATE PROFICIENCY IN TIMING SYSTEMS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE

NONE

15.0 DEMONSTRATE PROFICIENCY IN TIME DELAY CIRCUITS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE

NONE

16.0 DEMONSTRATE PROFICIENCY IN PROCESS CONTROL

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
NONE		

17.0 DEMONSTRATE PROFICIENCY IN TELEMETRY

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Electronic Communication Robert L. Shrader ISBN 0-07-057150-3	McGRAW-HILL BOOK COMPANY	text
Microwave Solid-state Devices Samuel Y. Liao	PRENTICE-HALL, Division of Simon & Schuster	text

18.0 DEMONSTRATE PROFICIENCY IN SYSTEMS INTERFACE

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
NONE		

PUBLISHERS' ADDRESSES

AMATROL INC.
Post Office Box 2697
Jeffersonville, IN 47131
812 288-8285

AMERICAN TECHNICAL PUBLICATIONS, INC.
1155 West 175th Street
Homewood, IL 60430
800-323-3471

BERGWALL PRODUCTIONS
Post Office Box 238
Garden City, NY 11530
800-645-3565

DELMAR PUBLISHING
2 Computer Drive West
Albany, NY 12212
518-459-1150

HARCOURT BRACE JOVANOVICH
6277 Sea Harbor Drive
Orlando, FL 32887-0001
407-345-2000

HEATH COMPANY, VEC EDUCATIONAL DIVISION
Post Office Box 1288
Benton Harbor, MI 49022
800-253-0570

HOLT, RINEHART & WINSTON,
Division of CBS College Publishing
383 Madison Avenue
New York, NY 10017
212-750-1330

HOWARD W. SAMS AND COMPANY,
Division of Macmillan, Inc.
4300 West 62nd Street
Indianapolis, IN 46268
800-428-7267

JOHN WILEY & SONS, INC.
605 Third Avenue
New York, NY 10158
212-850-6418

MERRILL PUBLISHERS
1300 Alum Creek Drive
Columbus, OH 43216
800-848-6205

MOTOROLA COMMUNICATIONS AND ELECTRONICS, INC.
2604 West 9th Street
Witchita, KS 67203-4792
316-832-0121

McGRAW-HILL BOOK COMPANY
1221 Avenue of the Americas
New York, NY 10020
212-512-2000

PRENTICE-HALL MEDIA
90 South Bedford Road
Mt. Kisco, NY 10549
914-631-8300

PRENTICE-HALL,
Division of Simon & Schuster
Route 9 West
Englewood Cliffs, NJ 07632
201-592-2000

RAMCO ELECTRIC CO.
1207 Maple Street
West Des Moines, IOWA 50265
515-225-6933

SCIENCE INSTRUMENTS COMPANY
6122 Resisterstown Road
Baltimore, MD 21215
301-358-7810

FACILITIES

Facility Design Recommendations

Facilities, tools and equipment are essential parts of training programs, and must be designed to meet State program standard requirements and instructional objectives. This section of the Program Guide contains information for setting up classroom and laboratory facilities. Facility design criteria and space requirements are specified in **S.B.E. Section B, Chapter 6A-2.**

TEACHING FACILITIES

The instructional environment should duplicate, as closely as possible, the real-life work environment the student will enter after graduation. The more the school resembles the industrial environment, the easier it will be for the student to make the transition from school to work. Tools, supplies and equipment should conform to local industry standards. The teacher should actively pursue supplemental resources to expose the students to state-of-the-art equipment.

All facilities should include classroom space, as well as space for regular classroom equipment such as audio-visual equipment. Laboratory facilities should be equipped with work stations or workbenches, tables, chairs and special training aids to demonstrate basic principles and theory. They should contain enough tools and equipment to enable several students to work individually on the same learning activity.

UPDATING FACILITIES

To keep pace with technological changes and improvements, facilities must be updated on a continuing basis. When planning facilities, priority must be given to provide space which will fulfill changing needs of the instructional program. Buildings should be designed with flexibility to expand in order to accommodate future program changes and to allow for greater ease of facility updating. The program advisory committee should be used to assist the school in establishing priorities for obtaining facilities, tools and equipment. Careful planning and analysis of current and future needs will lead to the establishment of an effective training environment.

SCHOOL FACILITIES

Industrial Electronics

This section of the program guide provides guidelines for Industrial Electronics program facilities. All vocational programs must meet additional facility requirements specified in **S.B.E. Section B, Chapter 6 A-2.**

The classroom/laboratory areas should include sufficient student work stations. Each work station should be equipped with special lighting, as necessary. The work stations should provide shelving on which test equipment will be placed. The shelving should be above or adjacent to the banch work area.

The laboratory should include electrical outlets providing 110 volts at each work station. Electrical outlets should be permanently mounted to the work station benches. Additional electrical outlets should be installed along the walls and in the center areas of the laboratory. Electrical outlets in the center areas should be mounted on posts between the ceiling and work stations or on pull down extension systems. Special electrical wiring may be required to supply the power requirements of specialized equipment. All electrical service must be installed according to local building code requirements.

CLASSROOM/LABORATORY FACILITIES

Space requirements for **new** facility construction for this program are specified in **S.B.E. Rule 6A-2.032** as shown below.

NEW FACILITIES
INDUSTRIAL ELECTRONICS

Occupant Design Stations	20
Net Square Feet Per Occupant	
Minimum	72
Normal	76
Maximum	79
Total Net Square Feet	
Minimum	1440
Normal	1520
Maximum	1580

WORK STATION ARRANGEMENT

The arrangement of work stations and specialized equipment depends upon the general layout of the facilities, but careful consideration must be given to convenience to entrances and exits, easy movement among work stations and tool/storage areas. The area should have a counter convenient to work stations. Overall layout of the facility should be planned so that the location of entrances and exits permits a logical flow of work in progress. One of the most critical factors in planning a facility is the arrangement of work stations to obtain a safe, efficient traffic pattern.

ADDITIONAL FACILITY CONSIDERATIONS

Training Stations

Training stations and live work areas must be available in the type and number required to meet program goals and performance objectives.

Instructional Area

A classroom or designated area of the laboratory should be available for lecture, instruction, viewing audio visual materials and other nonshop activities.

Personal Tool/Equipment Storage Area

A secure storage room or area should be provided, with enough shelf space for student supplies/tool boxes and floor space for equipment.

General Storage

Storage areas for tools, parts, supplies and machines must be sufficient to support the activities outlined in the program goals and performance objectives.

Office Space

An area separate from the classroom and laboratory should be available and convenient for use by the instructor(s) as an office.

Maintenance

A regular facilities maintenance program must be implemented to ensure that equipment and facilities are safe and usable to meet instructional needs.

Housekeeping

The classroom, laboratory and support area(s) must be kept clean and orderly.

Ventilation

A fume/dust removal system should be in place and operable. When appropriate, heating and cooling systems should be used to provide sufficient comfort for learning. Ventilation requirements are stated in **S.B.E. Rule 6A-2.066.**

First Aid

A first aid station must be in place, well marked and complete with appropriate supplies.

Support Facilities

Restrooms, clean-up areas and lockers convenient to the shop should be available for students.

Safety

The facilities must meet all Occupational Safety and Health Administration (OSHA) safety standards, where applicable.

Facility Evaluation

The program advisory committee should be asked to conduct an annual evaluation of the facilities to ensure the program's continuing capability to meet instructional objectives.

Safety, Maintenance and Liability

SAFETY

S.B.E. Rule 6A-2.097

The Florida State Board of Education establishes rules for the operation of public schools. **Part III, Section B, Chapter 6A-2** of the State Board of Education Rules contains the standards for existing educational facilities. Subsections deal with the entire school facility in regard to such topics as electrical equipment, flammable materials, ventilation, fire safety, storage and illumination. Subsection 6A-2.097 contains safety regulations pertaining to vocational classes.

The statute requires 100 percent protection of every student and teacher participating in laboratory work wherein the type of activities listed in the statute above are conducted. This will include: demonstration by teachers or students, students and teachers present in a room or laboratory when students are engaged in make-up work or project work, and when anyone is using tools for construction or repair work involving the shaping or cutting of any solid materials.

Rules and regulations for an eye protection program should be organized and distributed to teachers, students and school personnel. Safety devices should be worn by those participating in the activity and by those who are observers or who may be in close proximity.

Marking of Hazardous Areas

Floors, walls, posts, stationary objects, machinery and equipment should be properly painted, marked, coded or identified, according to recommended safety practices of OSHA, the school board and industry.

Emergency Procedure For Injuries

The following procedures are recommended in the event of an injury or sudden illness in a student:

- Refer to the red "fire or medical emergency" signs posted in appropriate areas.
- Provide immediate first aid if so qualified.
- Notify appropriate personnel to advise them of the problem. They can also contact emergency trained personnel on campus.
- A conscious person has the right to refuse treatment and/or transportation to a medical facility.
- Advise students that they will be financially responsible for ambulance and emergency care.
- The paramedics will assume patient care upon arrival.
- If emergency transportation is not indicated, the student may spend time at the clinic, be allowed to go home or go to a medical facility.
- Be sure to complete the appropriate student injury form for any and all accidents or sudden illness.

MAINTENANCE

Schools should have the necessary facilities for routine maintenance. Special maintenance requirements for this program concern the hand and power tools and machines. Arrangements must be made to accomplish routine and non-routine maintenance of hand and power tools and cutting and shaping machines. Arrangements can be made through the school's shop or an outside agency.

VOCATIONAL TEACHER LIABILITY

Liability of Teacher and School Board

Negligence of vocational education teachers can cause unnecessary injury, and may result in teacher and school district liability. Vocational teachers are recommended to carry personal liability insurance. To reduce the risk of liability and injuries, the following suggestions are provided.

- Follow accepted policies of the school board.
- Do not allow students to use equipment or tools which have not been approved by the administration and Board of Education.
- Establish safety rules and enforce them.
- Do not leave the shop/laboratory while students are working.
- Do not permit non-enrolled students to use the shop/laboratory.
- Do not allow students to use machines or tools for which instruction has not been given.
- Do not approve unsupervised student activities inside or outside the shop/laboratory.
- Prepare accident forms for all accidents.
- Regularly inspect the workplace and equipment for defects or potential hazards and maintain documentation of unserviceable or hazardous items.
- Consider age, maturity, skill and ability of students when providing instruction and supervision.
- Adminster safety tests to students upon completion of the demonstration of a specific machine, tool or process and keep documentation on file in your office.
- Require all students to wear eye protection devices, when appropriate, for laboratory activities.

SUGGESTED EQUIPMENT LIST

General Classroom Equipment

DESCRIPTION

Chalkboard

Bulletin board

Bookcases

Cabinet-storage

Student study stations

Audio-visual equipment as needed

Laboratory Tools and Equipment

These tools and items of equipment are normally used in this program. Equipment items are listed under each outcome, corresponding to the curriculum framework. Consumable supplies should be readily available to assure continuous instruction. Consumable supplies such as solder and wire are not contained in the equipment list.

01.0 DEMONSTRATE PROFICIENCY IN INDUSTRIAL POWER SUPPLIES

DESCRIPTION

Control transformers, three/single phase (Square D 100 VA or equivalent)
Rotating machines technology training package (LJ Systems RM02 or equivalent)
Single phase transformer (Digiac Auto-Transformer 605-60 or equivalent)
Three phase transformer (Digiac Variable Transformer 605-50 or equivalent)

02.0 DEMONSTRATE PROFICIENCY IN POWER DISTRIBUTION SYSTEMS

DESCRIPTION

NONE

03.0 DEMONSTRATE PROFICIENCY IN BASIC CONTROL SYSTEMS

DESCRIPTION

Control relay trainer (Digiac model 644-65 or equivalent)
Input control unit (Digiac model 644-05 or equivalent)
Pushbutton station (Digiac model 644-12 or equivalent)
Switch unit (Digiac model 644-70 or equivalent)
Synchronizing lights (Digiac model 613-70 or equivalent)
Time delay relay trainer (Digiac model 644-66 or equivalent)

04.0 DEMONSTRATE PROFICIENCY IN DC MOTORS

DESCRIPTION

Base unit (Digiac or equivalent) to include mechanical and electrical facilities for mounting and interconnecting equipment, power cords, patch cords, input power and rheostat fuse protectors
Benchpack power supply (Digiac model 105-3P or equivalent)
Hand tachometer (Digiac model 426-00 or equivalent)
Prony brake (Digiac model 613-43 or equivalent)

05.0 DEMONSTRATE PROFICIENCY IN DIGITAL MOTOR CONTROL

DESCRIPTION

Analog and digital control trainer (LJ Technical Systems model CA04 [6502] or equivalent)
Control boxes/panels
Drives, DC, classroom mock up
Motor starters, industrial

Preassembled printed circuit board (Digital Techniques SIP 390 [Science Instruments Product] or equivalent) for introducing basic principles of solid-state devices and logic control for industrial process control programs
Relays, overload, thermal/magnetic

06.0 DEMONSTRATE PROFICIENCY IN MANUAL CONTROLLERS

DESCRIPTION

Dynamometer load control (Digiac model 613-25 or equivalent)
Face plate starters
Wound rotor induction motor (Digiac model 613-17D or equivalent) for measuring thermal rise under various load conditions

07.0 DEMONSTRATE PROFICIENCY IN MAGNETIC CONTROLLERS

DESCRIPTION

Automation control training package (LJ Systems PC02 or equivalent)

08.0 DEMONSTRATE PROFICIENCY IN PRESSURE AND STRAIN MEASUREMENTS

DESCRIPTION

Transducer work station (Digiac 1750 Transducer and Instrumentation Trainer or equivalent) for introducing temperature sensing, strain measurement and flow-rate measurement
Transducers, assorted, commercial

09.0 DEMONSTRATE PROFICIENCY IN TEMPERATURE CONTROL

DESCRIPTION

Temperature sensors
Thermistors

10.0 DEMONSTRATE PROFICIENCY IN PHOTOELECTRIC CONTROL

DESCRIPTION

Fiber optics kit including, light source, photodetector, photodiode, phototransistor, optoisolators, photoelectric sensors

11.0 DEMONSTRATE PROFICIENCY IN GAS AND HUMIDITY SENSORS

DESCRIPTION

Conductivity cells
Density meter
Humidity transmitter
Sling hydrometer

12.0 DEMONSTRATE PROFICIENCY IN LIQUID LEVEL CONTROLS

DESCRIPTION

Preassembled board (Programmable Fluid Controller Kit SIP410-1 or equivalent) for teaching manual and programmable logic control (PLC) methods in pnuematic and hydraulic operations

13.0 DEMONSTRATE PROFICIENCY IN LINE DIAGRAMS AND LOGIC FUNCTIONS

DESCRIPTION

Conveyor (PC15 Stand Alone Conveyor or equivalent)
Logic relay (PC5/IBM Ladder Logic Program Software Package or equivalent)
Sequence switch (PC11 Sequence Switch Module or equivalent)
Sequencing (PC12 Sequence Indicator Module or equivalent)

14.0 DEMONSTRATE PROFICIENCY IN TIMING SYSTEMS

DESCRIPTION

Frequency counter
Oscilloscopes
ime clocks - program timers, sss timers

15.0 DEMONSTRATE PROFICIENCY IN TIME DELAY CIRCUITS

DESCRIPTION

NONE

16.0 DEMONSTRATE PROFICIENCY IN PROCESS CONTROL

DESCRIPTION

Preassembled digital motor control circuit board (LJ Systems
MA06 or equivalent)
Programmable logic controllers (PLC)

17.0 DEMONSTRATE PROFICIENCY IN TELEMETRY

DESCRIPTION

NONE

18.0 DEMONSTRATE PROFICIENCY IN SYSTEMS INTERFACE

DESCRIPTION

NONE

PROFESSIONAL DEVELOPMENT

Teacher Technical Updating

Technical updating workshops are scheduled periodically throughout the State, usually in the summer months. Teachers should take advantage of the opportunity to attend the Industrial Electronics program technical update workshops when they are held. All instructional staff are encouraged to participate in as many training opportunities as possible.

Teachers should seek opportunities with local companies to maintain currency with industry trends. During periods when school is not in session, teachers are encouraged to make arrangements to return to industry for suitable involvement in their area of expertise.

Membership in professional associations offers vocational educators an enormous range of opportunities for working together to strengthen the field and to develop personal competence and satisfaction in work. The associations have similar goals and activities. They seek excellence in program content by means of joint efforts among members, communications that keep members current, forums for the discussion of issues in the field, useful and stimulating publications and sound professional growth experiences at local, state, regional and national meetings and annual conventions. They are concerned with increasing public understanding and support of the field. Teachers are encouraged to maintain affiliation with professional organizations. A list of professional organizations follows this section of the guide.

Teacher Standards

As a prerequisite to certification, teachers must have the required years of experience in the appropriate technical field as defined in the certification standards. For the Industrial Electronics program, the requirements are six years continuous experience in electronics. The teacher is then judged qualified to teach upon meeting one of the following criteria: (1) regular or temporary Florida teacher's certificate with appropriate coverage, (2) approval of local school board consistent with adopted school policy or (3) regular or temporary Florida teacher's certificate with other than appropriate coverage (has met all occupational experience requirements prescribed as a prerequisite to appropriate certification and has been approved by the school board to teach out-of-

field). Refer to the Curriculum Framework for this program to determine the appropriate occupational specialization coverage required for certification.

Instructional staff must have technical competency and meet all State and local requirements for certification. Instructors should hold current, nationally recognized certification in the subject areas taught, if awarded. Beginning teachers must be enrolled in the State Beginning Teacher Program.

A systematic method of obtaining "substitute" instructors, approved by the school board, should be used to assure instructional continuity. An orientation session for substitutes should be held on a regular basis. The substitute should be a competent instructor in the occupational area and specific competencies taught.

Professional Organizations and Support Services

EDUCATION ORGANIZATIONS

AMERICAN VOCATIONAL ASSOCIATION (AVA)
1410 King Street
Alexandria, VA 22314
800-826-9972

FLORIDA ASSOCIATION FOR TRADE AND INDUSTRIAL EDUCATION, INC. (FATIE)
Florida Department of Education
Industrial Education - Vocational Division
Knott Building
Tallahassee, FL 32399
904-488-0484

FLORIDA VOCATIONAL ASSOCIATION (FVA)
1420 North Paul Russell Road
Tallahassee, FL 32399
904-878-6860

FLORIDA VOCATIONAL INDUSTRIAL CLUBS OF AMERICA (VICA)
Florida Department of Education
Knott Building
Tallahassee, FL 32399
904-488-0484

TRADE ORGANIZATIONS

This list contains trade associations and technical societies. Many offer training programs of some sort, either directly or through their member companies. Specific details should be requested in writing.

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION (AFCEA)
4400 Fair Lakes Court
Fairfax, VA 22033-3899
703-631-6178

NATIONAL ASSOCIATION OF RADIO AND TELECOMMUNICATIONS ENGINEERS (NARTE)
Post Office Box 15029
Salem, OR 97309
503-581-3336

ELECTRONIC INDUSTRIES ASSOCIATION
2001 Eye Street, Northwest
Washington, DC 20006
202-457-4900

IEEE COMMUNICATIONS SOCIETY
c/o INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS
345 East 47th Street
New York, NY 10017
212-705-7867

COMPUTER AND COMMUNICATIONS INDUSTRY ASSOCIATION
666 11th Street, Northwest
Washington, DC 20001
202-783-0070

ASSOCIATION OF COMMUNICATIONS TECHNICIANS
(also) NATIONAL ASSOCIATION OF BUSINESS AND EDUCATIONAL RADIO
Alexandria, VA 22314
703-739-0300

CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION
1990 Elm Street, Northwest, Suite 610
Washington, DC 20036
202-785-0081

NATIONAL SOUND AND COMMUNICATIONS ASSOCIATION
501 West Algonquin Road
Arlington Heights, IL 60005
312-593-8360

COMPUTER AND BUSINESS EQUIPMENT
MANUFACTURING ASSOCIATION (CBEMA)
311 First Street, Northwest, 5th Floor
Washington, DC 20001
202-737-8888

COMPUTER AIDED MANUFACTURING INTERNATIONAL (CAM-I)
611 Ryan Plaza Drive, Suite 1107
Arlington, TX 76011
817-860-1654

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
2101 L Street, Northwest, Suite 300
Washington, DC 20037
202-457-8400

AMERICAN ELECTRONIC ASSOCIATION (AEA)
2680 Hanover Street
Palo Alto, CA 94304
408-720-0117

ELECTRONICS TECHNICIANS ASSOCIATION, INTERNATIONAL (ETA-I)
604 North Jackson
Greencastle, IN 46135
317-653-8262

INSTITUTE FOR INTERCONNECTING AND PACKAGING
ELECTRONIC CIRCUITS (IPC)
7380 North Lincoln Avenue
Lincolnwood, IL 60646
312-677-2850

INTERNATIONAL SOCIETY OF CERTIFIED ELECTRONICS
TECHNICIANS (ISCET)
2708 West Berry, Suite #8
Fort Worth, TX 76109
817-921-9101

JOINT ELECTRONIC DEVICE ENGINEERING COUNCIL (JEDEC)
2001 Eye Street, Northwest
Washington, DC 20006
202-457-4971

NATIONAL ELECTRONIC SERVICE DEALERS ASSOCIATION (NESDA)
2708 West Berry Street
Fort Worth, TX 76109
817-921-9061

SEMICONDUCTOR EQUIPMENT AND
MATERIALS INTERNATIONAL (SEMI)
805 East Middlefield Road
Mountain View, CA 94043
415-964-5111

SEMICONDUCTOR INDUSTRY ASSOCIATION (SIA)
10201 Torre Avenue, Suite 275
Cupertino, CA 95014
408-973-9973

State of Florida
Department of Education
Tallahassee, Florida
Betty Castor, Commissioner
Affirmative action/equal opportunity employer

IE566 BK-91

CAREER MERIT ACHIEVEMENT PLAN
(CAREER MAP)

INDUSTRIAL ELECTRONICS

(0647.010500)

_____

STUDENT'S NAME

State of Florida

An affirmative action/equal opportunity employer

DEPARTMENT OF EDUCATION
Betty Castor, Commissioner of Education

DIVISION OF VOCATIONAL, ADULT AND COMMUNITY EDUCATION
Robert S. Howell, Director

DEVELOPED BY:
University of South Florida
Department of Adult and Vocational Education

INDUSTRY-BASED PARTNERSHIP PROGRAMS: The State of Florida is committed to the development of industry-based partnership programs, designed by education and industry to respond to industry's demand for a highly skilled work force.

ACKNOWLEDGEMENTS

The curriculum for the Industrial Electronics program was developed by the Florida Department of Education with assistance from representatives from industry and vocational education instructors.

For further information, contact
Bureau of Vocational Program and Staff Development
Division of Vocational, Adult, and Community Education
Department of Education
Knott Building
Tallahassee, FL 32399

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THIS MERIT ACHIEVEMENT PLAN RECORDS THE INDUSTRIAL ELECTRONICS ACHIEVEMENTS OF:

Student's Name _____

Student ID Number _____

Student's Address _____

_____

Initial Instructor _____

School _____

Date Started _____

PRIMARY JOB TITLE(S) FOR INDUSTRIAL ELECTRONICS

- Electronics Repairers OES#(828.281-010)
- Electronics Mechanics DOT#(828.281-010)

Program completers qualify for the primary job title(s) listed above. Related job titles may be added based on those job titles found in industry and/or the Dictionary of Occupational Titles.

OVERVIEW

This Career MAP includes the competencies required for entry into the field of industrial electronics. Business and industry representatives have recommended that students in this field master these competencies in order to become employable. Local education agencies (LEAs) may adapt these competencies to meet their workforce needs.

PURPOSE OF THE MAP

The purposes of the MAP are: to display the student performance standards (SPS) required by the LEA and to document the level of achievement on student performance standards that the student demonstrates.

HOW TO USE THE MAP

Administrator and Instructor. The administrator and instructor can use Career MAPs in curriculum planning, program updating and improvement and teacher recruitment, selection and updating. If the LEA changes or adds student performance standards, the revised or additional student performance standards should be included in the blank boxes that appear within each intended outcome or at the end of this MAP.

Instructor. The instructor can use Career MAPs to keep track of student progress on student performance standards. By periodically reviewing the ratings on student performance standards, the instructor can identify a student's strengths and weaknesses and, on that basis, identify the skills for which the student needs remedial instruction or advanced training. The MAP can also be useful in student counseling and evaluation.

Co-op Instructor/Employer. The employer who sponsors a co-op program should use the Career MAP for keeping a record of the student's performance on appropriate standards. The MAPs will also help the co-op instructor/employer in counseling and evaluating the student.

Student. The student may use the MAP to show potential employers the performance standards he or she has mastered. In order to present a complete record, the student should encourage the instructor/co-op employer to rate his or her level of achievement on all the appropriate student performance standards and to fill in the verification form/cooperative work experience page in the back of this MAP.

Employer. The MAP shows an employer the student performance standards mastered by the student (a prospective employee) and the proficiency level achieved on each student performance standard. This information can help the employer make decisions about hiring, job assignments and job-training needs.

RATING STUDENT PERFORMANCE STANDARDS

Performance Competencies. Ratings on student performance standards should be based upon business/industrial performance standards. The evaluator observes and evaluates student performance as he or she would in the role of the employer or supervisor.

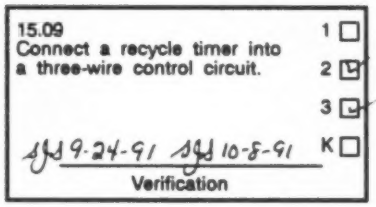
For each skill listed the learner receives a rating of 1, 2 or 3. Each rating indicates a particular level of achievement:

1 = Learner demonstrates knowledge and understanding of this student performance standard, but is not yet able to apply that knowledge or understanding.

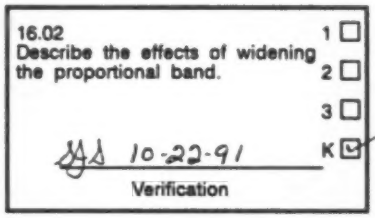
2 = Learner performs this student performance standard satisfactorily with only periodic supervision.

3 = Learner performs this student performance standard satisfactorily without supervision.

Whenever a performance standard is demonstrated, the instructor checks the appropriate rating box (1, 2 or 3) and initials and dates the verification line. If the student later demonstrates a higher level of achievement on a performance competency, the instructor checks the higher level and then enters his or her initials and the new date on the verification line, as shown in the following example:



Knowledge Competencies. For each SPS that is a knowledge competency only, with no manipulative skill involved, only one level of achievement is possible. If the student masters the competency, he or she receives a check in the bottom box ("K"), as shown below:



NOTE: A student performance standard without a checked rating indicates that the learner has not mastered the standard from lack of either ability, time, opportunity or need (the student's area of specialization may not have required it).

50

01.0 DEMONSTRATE PROFICIENCY IN INDUSTRIAL POWER SUPPLIES.

01.01 Connect an unregulated power supply, measure voltages & calculate percentage of regulation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.02 Decrease the power supply impedance to improve regulation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.03 Connect a shunt regulator circuit. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
01.04 Connect a series regulator circuit. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.05 Connect a switching voltage regulator. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.06 Set up a DC-to-AC inverter by adding a transformer module. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
01.07 Connect a delta-primary, wye-secondary arrangement & measure its voltage. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.08 Connect a half-wave power supply & measure voltages, ripple amplitude & ripple frequency. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.09 Connect a three-phase, full-wave power supply & measure output voltages with & without filtering. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
01.10 Connect a delta-primary, delta-secondary, full-wave power supply & measure output voltages with & without filtering. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.11 Connect the power supply module for single-phase or three-phase output voltage. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.12 Connect a step-down transformer to reduce the incoming voltage. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

02.0 DEMONSTRATE PROFICIENCY IN POWER DISTRIBUTION SYSTEMS.

02.01 Connect & verify single-phase & three-phase transformers in WYE to WYE installations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	02.02 Connect & verify single-phase & three-phase transformers in DELTA to DELTA installations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	02.03 Connect & verify single-phase & three-phase transformers in WYE to DELTA installations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

02.04 Connect & verify single-phase & three-phase transformers in DELTA to WYE installations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

03.0 DEMONSTRATE PROFICIENCY IN BASIC CONTROL SYSTEMS.

03.01 Connect relays & lamp modules in a control system & determine the pull-in & drop-out currents. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.02 Connect relays & lamp modules in a control system & determine the operating characteristics of solid-state relay. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.03 Connect a multi-pushbutton control circuit for troubleshooting purposes. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.04 Connect a test light for STOP & START pushbuttons. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.05 Connect a test light for a control relay. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.06 Connect an on-off control station with a pilot light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.07 Connect a solid state limit switch & cycle timer. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.08 Connect a solid state limit switch to a control relay. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.09 Connect a selector switch to a control circuit. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

04.0 DEMONSTRATE PROFICIENCY IN DC MOTORS.

04.01 Measure the resistances of the two field coils in a DC motor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	04.02 Connect a series type motor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	04.03 Measure the current drawn by the motor & calculate the CEMF generated in the motor for unloaded & loaded conditions. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
04.04 Connect a shunt type motor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	04.05 Measure the shunt motor currents & calculate the CEMF. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	04.06 Operate a compound motor with separate armature & field supply voltages. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
04.07 Operate a compound motor from a single power supply, with & without load, measuring motor current & observing changes in speed. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

05.0 DEMONSTRATE PROFICIENCY IN DIGITAL MOTOR CONTROL.

05.01 Connect a stepping motor to its DC supply. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.02 Vary the speed & direction of rotation of the stepping motor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.03 Program the logic source to make the motor perform in a predictable patter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
05.04 Program the stepping motor for control of rotary or linear displacement. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

06.0 DEMONSTRATE PROFICIENCY IN MANUAL CONTROLLERS.

06.01 Connect a manual starter to operate a three-phase motor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.02 Troubleshoot a manual starter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.03 Change motor rotation using a drum switch. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

07.0 DEMONSTRATE PROFICIENCY IN MAGNETIC CONTROLLERS.

07.01 Connect a standard start-stop pushbutton station to operate a magnetic motor starter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	07.02 Troubleshoot the control circuit & the power circuit. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	07.03 Connect start-stop pushbutton stations to control magnetic starters. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
07.04 Connect the STOP pushbutton through a logic relay for NOT, NOR, & & NAND circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	07.05 Connect motors arranged for sequence control of a conveyor system. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	07.06 Interconnect starters to control a conveyor system so as to prevent pile ups & assure safe operation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
07.07 Connect a motor using a selector switch & a jogging relay. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

08.0 DEMONSTRATE PROFICIENCY IN PRESSURE AND STRAIN MEASUREMENTS.

08.01 Connect a linear Hall sensor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	08.02 Apply amplification to the linear Hall sensor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	08.03 Connect a digital Hall sensor as a hysteresis type of load switch. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
08.04 Connect a digital Hall sensor as a sensitive load cell. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	08.05 Connect the AC response of the linear variable differential transformer (LVDT) to indicate mechanical position change. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

09.0 DEMONSTRATE PROFICIENCY IN TEMPERATURE CONTROL.

09.01 Connect a temperature module, calibrate the integrated circuit for reading temperature & measure the cold resistance of the thermistor. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.02 Measure temperature by using a thermocouple mounted on an op-amp module. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.03 Apply amplified voltage change at the op-amp output to operate a solid-state relay & an indicating device. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
09.04 Use an op-amp, relay, lamp & temperature module to set up a system that maintains temperature at a constant level. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.05 Connect a bridge, temperature module & thyristor module into a closed-loop temperature control system. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.06 Connect a voltage-controlled oscillator module & determine the range of control voltage necessary for oscillation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

09.07 Connect a temperature & voltage-controlled oscillator module to provide digital readout of temperature. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

10.0 DEMONSTRATE PROFICIENCY IN PHOTOELECTRIC CONTROL.

10.01 Connect a photoconductive cell & incandescent lamp & measure the effect on photocell resistance. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.02 Use a photo-Darlington transistor to receive light from an incandescent lamp & measure its effect on collector voltage with a change of light intensity. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.03 Connect a photoelectric relay circuit to turn lights on & off. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
10.04 Operate & adjust a fiber optic transmitter for minimum distortion. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.05 Operate & adjust a fiber optic receiver for maximum sensitivity & minimum distortion. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.06 Transmit a voice signal from a transmitter to a receiver through an optical cable. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
10.07 Transmit digital data through an optical cable. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

11.0 DEMONSTRATE PROFICIENCY IN GAS AND HUMIDITY SENSORS.

11.01 Measure the resistance of a hygropak humidity sensor under varying conditions of humidity. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.02 Simulate a wet & dry bulb humidity measurement device using a thermistor as the active element. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.03 Connect a gas detector circuit using a Taguchi gas sensor & measure its cold & hot resistances. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
11.04 Use a gas sensor as a smoke detector, coupled with a solid-state relay & lamp, to act as an indicator. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

12.0 DEMONSTRATE PROFICIENCY IN LIQUID LEVEL CONTROLS.

12.01 Connect a level switch to control a pump motor for sump operation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.02 Add a timer to a level control circuit to keep the pump motor running for a set time after the level has dropped. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.03 Add a time to level control circuit to start a second pump motor if the first cannot lower the level after a given time. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
12.04 Use the float switch control starter for tank operation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.05 Use the pump operating system to provide backspin & surge protection on stopping. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

13.0 DEMONSTRATE A PROFICIENCY IN LINE DIAGRAMS AND LOGIC FUNCTIONS.

13.01 Connect control switches for AND circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.02 Connect control switches for OR circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.03 Connect a control switch for NOT circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
13.04 Connect switches for NOR circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.05 Connect control switches for NAND circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.06 Connect a logic relay for OR circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
13.07 Connect a logic relay for AND circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.08 Connect a logic relay for NOR circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.09 Connect a logic relay for NAND circuit logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
13.10 Connect a control relay in a circuit to add memory to the circuit. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.11 Connect a logic relay together with a control relay to form a combination of memory with either OR or AND logic. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

14.0 DEMONSTRATE PROFICIENCY IN TIMING SYSTEMS.

14.01 Construct a time delay circuit using an RC network & a silicone controlled rectifier. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	14.02 Adjust the time delay relay circuit for different time delays. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	14.03 Use a frequency divider as a timing device to obtain different time delays. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

14.04 Change the repetition rate of the signal applied to a frequency divider to obtain different time delays. 1 2 3 K Verification	14.05 Combine the inputs & outputs of two frequency dividers to increase the total division & obtain time delays using a signal having a higher repetition rate. 1 2 3 K Verification	14.06 Connect a time delay circuit using an integrated circuit & a solid-state relay & measure different time delays. 1 2 3 K Verification
14.07 Connect a time delay circuit using an operational amplifier to keep a device turned off for a definite period of time. 1 2 3 K Verification	14.08 Measure the frequency or repetition rate of a sine-wave or square-wave signal. 1 2 3 K Verification	14.09 Change the function gate time & determine the readout on a digital counter. 1 2 3 K Verification
14.10 Use the digital counter to measure low frequencies by measuring the period of a waveform or pulse. 1 2 3 K Verification	1 2 3 K Verification	1 2 3 K Verification
1 2 3 K Verification	1 2 3 K Verification	1 2 3 K Verification

15.0 DEMONSTRATE PROFICIENCY IN TIME DELAY CIRCUITS.

15.01 Connect an on-delay timer to sequence start two motors. 1 2 3 K Verification	15.02 Connect an on-delay timer to automatically turn off a second motor while the first remains on. 1 2 3 K Verification	15.03 Connect an off-delay timer to keep a second motor running for a set period of time after the first is turned off. 1 2 3 K Verification
15.04 Connect an off-delay timer used to prevent a motor from restarting until the time setting is past. 1 2 3 K Verification	15.05 Connect an off-delay timer for deceleration control. 1 2 3 K Verification	15.06 Connect a one-shot timer to keep a load turned on for a set period of time regardless of how long the switch-on control is closed. 1 2 3 K Verification
15.07 Use a one-shot timer to turn on a second motor for a short period of time after the first motor is started. 1 2 3 K Verification	15.08 Connect a recycle timer into a two-wire control circuit. 1 2 3 K Verification	15.09 Connect a recycle timer into a three-wire control circuit. 1 2 3 K Verification

1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

16.0 DEMONSTRATE PROFICIENCY IN PROCESS CONTROL.

16.01 Explain the operation of a two-position controller & its applications. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	16.02 Describe the effects of widening the proportional band. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	16.03 Evaluate a proportional circuit based on test data. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
16.04 Describe the action of a backup control in a proportional circuit. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	16.05 Describe the operation of a direct digital control in an industrial process. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

17.0 DEMONSTRATE PROFICIENCY IN TELEMETRY.

17.01 Connect a telemetry transmitter to a power supply & observe the carrier output waveform with & without modulation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	17.02 Measure the carrier frequency of a telemetry transmitter & observe the effects of modulation on the frequency. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	17.03 Measure the input frequency of a telemetry receiver. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
17.04 Measure the band-pass of a telemetry receiver. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	17.05 Transmit a 200 Hz audio tone between two separate points using a telemetry transmitter & receiver. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	17.06 Transmit an analog voltage between two separate points using a telemetry transmitter & receiver. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

17.07 Transmit two separate information channels using a single carrier & time-division multiplexing. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

18.0 DEMONSTRATE PROFICIENCY IN SYSTEMS INTERFACE.

18.01 Construct a frequency shift keying (FSK) generator using frequency division. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.02 Construct an FSK generator using a voltage-to-frequency converter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.03 Set up & adjust a phase-locked loop frequency-to-voltage converter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
18.04 Use a frequency-to-voltage converter to demodulate an FSK signal. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.05 Set up & adjust a charge-pump frequency-to-voltage converter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.06 Verify the truth table of a BCD coded switch. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
18.07 Verify the analog output voltage of a four-bit digital-to-analog converter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.08 Connect an analog-to-digital converter & observe ramp generation & counter operation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.09 Calibrate a binary-ramp analog-to-digital converter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
18.10 Generate binary numbers 0000 through 1111 & verify their analog equivalents. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.11 Interface a four-bit digital signal with a heating element & observe its controlling effect. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	18.12 Interface a four-bit digital signal with a light bulb & observe on-off control. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

INDUSTRIAL ELECTRONICS

0.0 DEMONSTRATE EMPLOYABILITY SKILLS.

0.01 Conduct a job search. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.02 Secure information about a job. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.03 Identify documents that may be required when applying for a job. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
0.04 Complete a job application form correctly. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.05 Demonstrate competence in job interview techniques. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.06 Identify or demonstrate appropriate responses to criticism from employer, supervisor or other persons. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
0.07 Identify acceptable work habits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.08 Demonstrate knowledge of how to make job changes appropriately. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.09 Demonstrate acceptable employee health habits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

00.0 DEMONSTRATE AN UNDERSTANDING OF ENTREPRENEURSHIP.

00.01 Define entrepreneurship. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.02 Describe the importance of entrepreneurship to the American economy. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.03 List the advantages & disadvantages of business ownership. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
00.04 Identify the risks involved in ownership of a business. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.05 Identify the necessary personal characteristics of a successful entrepreneur. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.06 Identify the business skills needed to operate a small business efficiently & effectively. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

P.O.W.E.R. SKILLS (PRINCIPLES OF WORK ENVIRONMENT READINESS)

000.0 COOPERATIVE WORK EXPERIENCE COMPETENCIES.

1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

VERIFICATION

The instructor should verify the level of mastery achieved by the student by initialing the competency box each time the student masters a competency. Later, if the student achieves a higher degree of mastery of a competency, the higher degree should be recorded and verified by the instructor.

INSTRUCTOR SHOULD SIGN FULL NAME AND SCHOOL NAME AND ADDRESS IN THE SPACE BELOW.

_____ Verification	_____ Signature _____ Title _____ School Name _____ School Address _____
_____ Verification	_____ Signature _____ Title _____ School Name _____ School Address _____
_____ Verification	_____ Signature _____ Title _____ School Name _____ School Address _____

COOPERATIVE WORK EXPERIENCE

In addition to classroom training and laboratory performance identified on the Career MAP, this student has participated in cooperative work experience with employers as shown below:

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

NOTES

This section of the MAP is provided so the instructor, employer, or student may list additional qualifying statements or other pertinent information. All comments should be initialed for verification.

State of Florida
Department of Education
Tallahassee, Florida
Betty Castor, Commissioner
Affirmative action/equal opportunity employer

IE575 BK-91